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QUANTITATIVE INDICATORS FOR DEFENSE ANALYSIS.
VOLUME I. EXECUTIVE SUMMARY

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FINAL REPORT

QUANTITATIVE INDICATORS FOR DEFENSE ANALYSIS

Volume I

Executive Summary

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The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the Defense Advanced Research Projects Agency or the U.S. Government.

PREFACE

This report describes research efforts undertaken by CACI, Inc., to develop and apply quantitative indicators to national security problems. This research was supported by the Defense Advanced Research Projects Agency, Contract No. MDA903-75-C-0013.

The report consists of two volumes. Volume I, the Executive Summary, is a non-technical review of the research accomplishments with special emphasis on their potential, immediate applications within the defense and intelligence communities. Volume II, the Technical Report, begins with an expanded, somewhat more technical, summary of the specific results of the fiscal 1975 research effort (Chapter 1). Chapters 2 through 9 review the research effort in detail. Volume III contains appendices to the Technical Report. Procedures and rationale for new indicators and methodologies for manipulation are described. These indicators and methodologies are then applied to research questions concerning the national security behavior of Japan and the results are reported and evaluated.

PROJECT PARTICIPANTS

The final report was prepared by:

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QUANTITATIVE INDICATORS FOR DEFENSE ANALYSIS

Executive Summary

INTRODUCTION

For the past several years ARPA has been pursuing a program designed to increase the development and application of quantitative indicators to national security problems. This research has progressed to a point where new indicators and methodologies have been developed and shown to be of positive assistance in the DoD community. Previous years' work has sought to develop indicators that accurately reflect ongoing political processes in the international sphere. Building on these past efforts, fiscal 1975 work proceeded substantially beyond the phase of indicator development, recasting both indicators and analytic and display methodologies into a substantively informed framework that reflects the real interests and information available to intelligence analysts, area specialists, and policy decision-makers. This emphasis on practicality has resulted in the development of new indicators and systems of indicators that permit substantively based measurement, monitoring, prediction, and evaluation of national security affairs in various geographical arenas and important contemporary issue areas. The increased emphasis on substantive meaning is reflected in indicators and methodologies that were developed in fiscal 1975 research to:

- Represent the impact of domestic economic conditions on the international policy behavior of nations
- Represent the impact of international economic conditions on the international policy behavior of nations
- Represent the impact of domestic political conditions on the international policy behavior of nations
- Evaluate the effectiveness of U.S. and other nations' policies in inducing desired policy responses from other nations
- Predict and evaluate changes in policy behavior by nations in their relations with the United States and other nations.

- Predict and evaluate the impact of specific international economic, political, and military issues on the international policy behavior of nations.
- Display the multiple measures of the quality of interactions between nations over time.

Quantitative indicators are representations of complex political phenomena that can aid analysts in following and interpreting national security developments in both short-term and long-term perspectives. They may be aggregate summaries of important political event occurrences such as diplomatic interactions between nations, favorable and unfavorable statements by national leaders about important policies or events, or military encounters between nations that signal imminent escalation of hostilities. Quantitative indicators may also be used to represent and trace over time the levels and rates of growth and change in different national economies, or in popular support for incumbent governments. Because of their longitudinal summarizing characteristics, quantitative indicators may be of assistance in predicting future trends with greater accuracy than is possible through subjective perceptions.

The greater emphasis on substantive content in the past year's effort has resulted in the development of more precise indicator systems and a variety of prediction and evaluation methods. While these indicators are more complex than in previous years, the greater practical meaningfulness and adaptability of the indicators and methodologies to diverse questions and situations of interest to the defense community are felt to more than offset the greater technical complexity. Every effort has been made to provide analytic routines and display capabilities that provide easily interpretable end products.

APPLICATIONS OF QUANTITATIVE INDICATORS

In their present form, quantitative indicators are adaptable for application in a variety of areas of interest to the defense community including:

- Defense intelligence estimates
- Forecasting for planning
- Simulation and gaming
- Logistics planning and analysis
- Measurement and evaluation of the impact of MAAGs, MAP, and arms transfers.

APPLICATIONS IN DEFENSE INTELLIGENCE ESTIMATES

Because quantitative indicators are designed to measure, monitor, predict and evaluate economic, political, and military processes in the international system, they are of direct utility in generating defense intelligence estimates. The indicators and methodologies that have been developed to date may be used in several ways.

1. Quantitative indicators may be used to monitor relations between the United States and other nations. In particular, the quantitative indicators and the Event Patterning for Decision Analysis approach developed in fiscal 1975 research provide an early warning system to identify shifts in alignment patterns and basic changes in the quality of relations between nations.

The Event Patterning for Decision Analysis methodology has been used to analyze interactions between the Soviet Union and the United States. Very clear and quite different changes in the quality of interactions between the two nations were observed in mid-1968 and early 1972. In mid-1968 U.S. and Soviet behavior, as measured by newly developed indicators of

intensity (standardized frequency) and tone (a seven-point scale of positive to negative quality of public statements and actions) became closely coordinated in timing and nature, whereas their behavior had previously been quite uncoordinated. The evidence suggests that the 1968 shift was an early manifestation of a favorable Soviet disposition toward detente.

A second major shift in policy behavior was demonstrated to have occurred in 1972 in the aftermath of the Nixon-Brezhnev summit and the signing of the SALT I agreement. A future departure from the presently coordinated pattern of U.S. and Soviet policy behavior would likely signal an end to detente.

2. Quantitative indicators and the Event Patterning for Decision Analysis approach are also applicable in evaluating the impact of changes in U.S. relations with other countries on third parties.

In an analysis of the impact of political-military questions on U.S.-Japanese relations, it was observed that Soviet-Japanese interactions intensified shortly after the political-military issue became salient in U.S.-Japanese relations. In particular, Soviet diplomatic statements toward Japan tended to be quite positive when the Japanese position was relatively negative toward the United States. When Japanese-U.S. relations improved and the political-military issue subsided, Soviet interest in Japan also relaxed. Increased sensitivity to such subtle effects of U.S. policies can aid analysts in evaluating policy choices and in recommending appropriate alternative responses to decision-makers.

3. Quantitative indicators provide "real time" data that can be used to improve substantially short-term forecasting.

The CIA's current intention to implement Project SAFE by 1980 increases the need for development of indicator systems and information processing capabilities that can digest, summarize, and interpret vast quantities of information in brief periods of time. The existence of WWMCCS, with

its central functions of indications monitoring and crisis management, makes these same real-time information processing capabilities immediately desirable within the defense community.

Quantitative indicator research has demonstrated that easily interpretable summary measures of complex events and processes and sensitive prediction and evaluation routines can be readily developed and coordinated with in-depth textual reports. The past year's research effort demonstrated the feasibility of developing credible, substantively meaningful quantitative indicators from a detailed information source, FBIS, and of interfacing the quantitative analysis of indicators with both the detailed source information of FBIS and scholarly analyses and intelligence reports. This dual capability to produce summary indicators and to interface these with in-depth analyses thus facilitates both the immediate access to and interpretation of information and subsequent detailed analysis and evaluation.

4. Quantitative indicators and the new quantitative indicator methodologies can be used to support medium- and long-range forecasting of economic, political, and military trends. Such forecasts can be improved substantially when they are based on accurate replication and projection of historical trends.

The pattern analysis capability developed in fiscal 1975 quantitative indicator research provides a detailed visual representation of basic trends and facilitates the evaluation of the interaction and reciprocal influence of different trends. New quantitative indicators of economic performance and trade dependency, domestic political events, and international policy tone and intensity developed in the past year's quantitative indicator research have been incorporated into long-range environmental forecasts of the African, Middle Eastern, and Latin American environments currently being performed for J-5.

5. Quantitative indicators also provide a capability for the systematic evaluation and prediction of the impact of domestic political processes on international policy behavior.

Analyses performed on Japanese data during the past year's research indicated that while popular opinion had little direct influence on international behavior, executive policy statements were quite sensitive to the public attitudes and statements of opposition groups, particularly on political, military, and economic issues. The complexity of domestic influences on international policy was emphasized by the findings that domestic economic questions were strongly related to changing positions on economic and trade relations with the United States, the Soviet Union, Southeast Asia, and China, and on political-military relations with the United States and the Soviet Union. Pattern analysis documented that domestic concerns "developed" at different points in time in response to sharp shifts in the domestic as well as the international economic and political environments.

The tracking capability provided by quantitative indicator techniques permits analysts to learn different nations' likely responses to such shifts in environmental conditions. It can also sensitize them to those domestic trends that have the greatest influence on international policy behavior and that therefore should be monitored closely. Questions currently being raised within the intelligence community about the impact of changes in Southern Europe on the political, military, and economic alignment stability of the Southern Flank could be successfully dealt with using presently available quantitative indicator techniques.

6. Quantitative indicators provide a capability for evaluating and predicting the impact of both domestic and international economic trends on the international behavior of nations.

Analyses of the impact of a variety of domestic and international economic linkages on Japanese international policy behavior produced quite satisfactory results in experimental forecasts in fiscal 1975 research. In particular, the analyses emphasized the importance of domestic economic performance, the availability of raw materials from different (and frequently new) trading partners, and the availability of markets as the prime

determinants of Japanese behavior toward the United States, the Soviet Union, and China. Indicators of exports to the United States and the Soviet Union proved particularly strong in this regard. A four- to six-month lead time for the economic indicators provided highly reliable predictions of policy behavior, suggesting that economic indicators may be particularly useful in short-term forecasting.

Economic theory provides a highly rigorous framework within which international political and economic dependencies may be evaluated and the impact of policy changes may be assessed. Analyses performed during fiscal 1975 quantitative indicator research and analyses performed under ARPA Contract MDA903-74-C-0291, "The Impact of Alternative International Economic Policies on U.S. Defense Interests Abroad," suggest strong relationships between nations' international behavior and their perceptions of the possible economic harm that may be suffered as a result of their own or other nations' policies. This research has great potential for assisting U.S. policy-makers in evaluating both the effects and probable effectiveness of alternative economic policy choices. The methods may be of particular utility in answering questions about the foundations and short- and long-term strength of European Southern Flank economic ties to northern Europe, and in identifying U.S. policy options in the Southern Flank in the event Portugal adopts a strong Communist position.

APPLICATIONS IN FORECASTING FOR PLANNING

All planning involves some estimation of the future values of indicators. Quantitative indicators provide objective, parsimonious summaries of historical patterns of those items and issues of interest to defense planners. They may be more readily incorporated into forecasts than can subjective perceptions, and the resultant forecasts can be evaluated with greater confidence and objectivity.

1. Quantitative indicator-based forecasts can make an important contribution to the early identification of problem areas, therefore permitting timely contingency planning.

2. Quantitative indicators can also be used to document the impact of specific policy decisions by the United States or other states, thereby permitting the prior review and evaluation of alternative policies. The power strategy impact technique, developed in the past year, indicated that effective strategies of influence are different, depending on the country target of the strategy and the issue--economic, political, or military--with which it was concerned. The analysis also indicated that punitive strategies by the United States toward Japan were counterproductive in that they failed to result in more cooperative behavior on the part of Japan and frequently resulted in more hostile behavior.

APPLICATIONS IN SIMULATION AND GAMING

Quantitative indicators may be used to support simulation and gaming exercises in a variety of ways.

1. The selection of scenarios to be gamed may be improved by the prior analysis of regional environments and problem areas. The pattern analysis approach developed in the past year's quantitative indicator research indicated that major policy changes developed gradually over time and therefore were "signalled" in advance. The pattern analysis plotting technique provided clear visual representation of the development of problem issues and areas in the international relations between states. Such analyses can provide a realistic background for staging games and will permit the identification of non-obvious problem areas.

2. Quantitative indicators provide game participants with readily useable information of specific items of concern, such as economic capabilities and dependencies, military preparedness, or domestic political instability, during the course of the game itself. These factors have often been ignored or dealt with in an inadequate fashion due to the lack of reliable, readily accessible and interpretable information. SAGA has expressed interest in the incorporation of quantitative indicators into the scenario generation and gaming process.

3. Quantitative indicators may be used to test the impact of alternative policy actions selected in the course of gaming against the real environment that the game is attempting to simulate. Such application of quantitative indicator decision aids can improve the evaluation of gaming exercises themselves, as well as indicate the relative merit of alternative policy choices.

APPLICATIONS IN LOGISTICS PLANNING AND ANALYSIS

Quantitative indicators can be used to forecast environmental conditions that impinge upon logistics decisions on foreign base use and availability, supply needs, transportation routes, critical materials availability, and equipment needs and availability.

1. Economic indicators may be used to identify future needs for and sources of critical materials. As political conditions change in various parts of the world, the availability of and access to established sources of critical materials may change and new sources and supply routes may need to be established. Projections of economic indicators can identify alternative sources and levels of supply for future dates.

2. Issue-specific policy tone and intensity indicators can be used to predict and evaluate threats to U.S. basing agreements and the likely success of negotiations for new or renewed basing rights, port facility access, or transit rights. The past year's analyses of U.S.-Japanese relations indicated considerable uncertainty and hostility between the two countries on issues of basing rights. Only a few of the U.S. efforts to encourage a more positive Japanese response on this issue were successful in producing less negative national attitudes as indicated in the power strategy impact analysis. Analysis of domestic factors influencing Japanese attitudes toward the United States on political/military issues, which included basing and berthing questions, indicated that this was a highly complex issue area. Concerns about domestic economic questions, third party (especially Soviet and Chinese) reactions, and the policy

positions of opposition groups all exercised influence over the Japanese Government's behavior on the issue.

3. Indicators of domestic political conditions, for example political stability or likely changes in government, may be used to predict and assess needs for reorientation of basing and supply agreements with individual countries. As basing facilities and location changes are identified, needs for and redistribution of equipment may be evaluated. The ability of quantitative indicators to signal the international political and economic conditions that impinge on logistics questions permits planners to evaluate base and supply needs in advance and in the context not only of U.S. capabilities but also of international circumstances that influence the ability to employ those capabilities.

Considerations of political and economic factors such as the above, in the course of logistics planning, can help in identifying contingencies that should be mapped out in advance to assure maximum support to U.S. forces in a variety of circumstances. Quantitative indicators may usefully be employed in the development of contingency plans for supplying the Middle East in the event of another outbreak of hostilities, or for supplying U.S. forces in the Atlantic and Pacific in the event of a shutdown of the Panama Canal.

APPLICATIONS IN THE MEASUREMENT AND EVALUATION OF THE IMPACT OF MAAGS, MAPS, AND ARMS TRANSFERS

Quantitative indicators are particularly useful in measuring and monitoring changes in domestic and international political conditions and in aiding in the evaluation of the impact of these changes on relations between nations.

1. Quantitative indicators provide early signals of increasing domestic and international tension that can be a valuable aid in determining whether or not arms transfers should be made to particular nations or

whether transfers would be likely to contribute to an escalation or stabilization of regional tensions or hostilities.

2. The monitoring of domestic political attitudes and activities of sub-national groups can be useful in determining the stability and likely longevity of governments to which arms are transferred, and whether undesirable successor governments or militant subnational groups are likely in the future to gain access to sophisticated transferred weapons.

3. Quantitative indicators may also provide useful tools for evaluating domestic political and military attitudes and perceived national security needs. Such evaluation can aid decision-makers in determining the types of MAAG and MAP programs to be established for different countries and regions and for evaluating their effectiveness over time.

4. Quantitative indicators of perceived national security needs may also be useful in evaluating the urgency with which arms requests should be responded to and MAAG and MAP programs should be developed. In fiscal 1975 research on political-military relations between Japan and the United States, analyses indicated that prolonged disagreements between the two countries on the issues of arms and bases were in large part due to U.S. failure to respond promptly to Japanese requests for arms and base negotiations. These requests were closely related to Japanese concern over the maintenance of the military balance of power in Asia. Early information on the depth and intensity of such concerns in other areas of the world may be useful to decision-makers in establishing response priorities.